9.0 Lakeview, Oregon, Disposal Site

9.1 Compliance Summary

The Lakeview, Oregon, Disposal Site, inspected on July 10, 2007, was in good condition. Rock degradation monitoring of west side slope riprap indicated that the mean diameter of the riprap (2.32 inches) remains above the recalculated minimum size (1.8 inches). Plant abundance cover on the cell top has gradually increased over the years as patches of deeper-rooted shrubs have spread; however, at the time of the 2007 annual inspection the vegetative cover was slightly more stressed than in 2006 because of dryer conditions. Evaluation of the effects of deep-rooted vegetation on the performance of the disposal cell cover by modeling the movement of water through the radon barrier using water flux meters continues. An investigation of root intrusion and soil permeability has shown that tens to hundreds of centimeters of rainwater infiltrates through the cover during dry and wet years. No cause for a follow-up or contingency inspection was identified.

9.2 Compliance Requirements

Requirements for the long-term surveillance and maintenance of the Lakeview, Oregon, Uranium Mill Tailings Radiation Control Act (UMTRCA) Title I Disposal Site are specified in the *Long-Term Surveillance Plan for the Collins Ranch Disposal Site, Lakeview, Oregon* (DOE/AL/62350–19F, Rev. 3, U.S. Department of Energy [DOE], Albuquerque Operations Office, August 1994) and in procedures established by DOE to comply with requirements of Title 10 *Code of Federal Regulations* Part 40.27 (10 CFR 40.27). These requirements are listed in Table 9–1. A revised LTSP for the site, prepared in August 2002, is pending NRC concurrence.

Table 9–1. License Requirements for the Lakeview, Oregon, Disposal Site

Requirement	Long-Term Surveillance Plan	This Report
Annual Inspection and Report	Section 6.1	Section 9.3.1
Follow-up or Contingency Inspections	Section 7.0	Section 9.3.2
Routine Maintenance and Repairs	Section 8.0	Section 9.3.3
Groundwater Monitoring	Section 5.3	Section 9.3.4
Corrective Action	Section 9.0	Section 9.3.5

Institutional Controls—The 40-acre disposal site is owned by the United States of America and was accepted under the NRC general license (10 CFR 40.27) in 1995. DOE is the licensee and, in accordance with the requirements for UMTRCA Title I sites, is responsible for the custody and long-term care of the site. Institutional controls at the disposal site, as defined by DOE Policy 454.1, consist of federal ownership of the property, a site perimeter fence, warning/no trespassing signs placed along the property boundary, and a locked gate at the entrance to the site. Inspectors found no evidence that these institutional controls were ineffective or violated.

9.3 Compliance Review

9.3.1 Annual Inspection and Report

The site, northwest of Lakeview, Oregon, was inspected on July 10, 2007. Results of the inspection are described below. Features and the photograph locations (PLs) mentioned in this report are shown on Figure 9–1. Numbers in the left margin of this report refer to items summarized in the Executive Summary table.

Seismic Activity—The Lakeview, Oregon, Disposal Site is located in a seismically active region. The United States Geological Survey National Earthquake Information Center notifies DOE when earthquakes of magnitude 3.0 or greater occur within 20 miles (0.3 degree) of a disposal cell and when earthquakes of magnitude 5.0 or greater occur within 70 miles (1 degree) of a disposal cell. Although there were some seismic events near the site in the recent past (2005), no seismic activity was reported in 2007.

9.3.1.1 Specific Site Surveillance Features

Access Road, Entrance Gate, Fence, and Signs—Access to the site is gained by traveling a gravel road that heads west off County Road 2–16B. DOE was granted a perpetual easement on the 1.2-mile access road between the county road and the DOE property boundary. A DOE lock is on a cable gate across the access road at a cattle guard approximately 0.4 mile east of the site.

A barbed-wire boundary fence surrounds the site and, overall, was in good condition. Damaged or loose wire strands occur along the northeast boundary fence. A lower strand of barbed wire along the western boundary is damaged or missing in places, allowing animals to enter the site in the past. The fence will be repaired in 2008.

The entrance sign was in good condition. Ten of the twelve perimeter signs were in good condition. Perimeter signs P9 and P12 have been damaged by gunfire but were legible. No perimeter signs were replaced in 2007.

Site Markers and Monuments—The two site markers, three survey monuments, and three boundary monuments were in excellent condition.

Monitor Wells—Nine monitor wells are in the groundwater-monitoring network. All of the wells that were inspected were found to be locked and in good condition.

9.3.1.2 Transects

To ensure a thorough and efficient inspection, the site was divided into three areas referred to as transects: (1) the top of disposal cell; (2) the side slopes of the disposal cell and adjacent drainage channel, aprons, and trench drains; and (3) the site perimeter and outlying area.

The area inside each transect was inspected by walking a series of traverses. Within each transect, the inspectors examined specific site surveillance features, drainage structures, vegetation, and other features. Inspectors also looked for evidence of settlement, erosion, or other modifying processes that might affect site integrity or the long-term performance of the site.

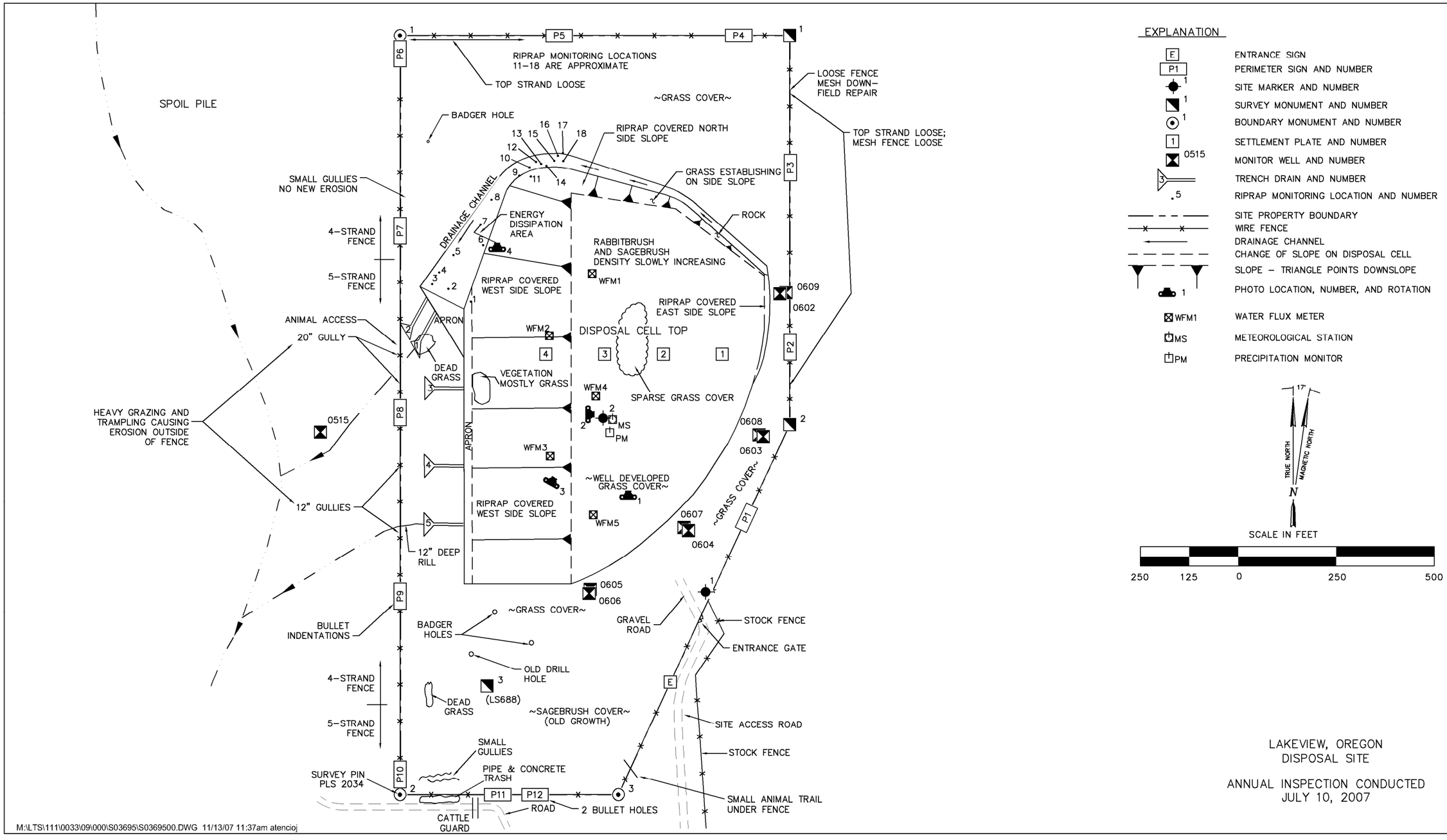

Figure 9–1. 2007 Annual Compliance Drawing for the Lakeview, Oregon, Disposal Site

Top of the Disposal Cell—The design for the top of the disposal cell has produced conditions that favor the growth of deep-rooted plants. The thin soil layer overlying a layer of rock on the top slope stores very little water, hence, most precipitation percolates deeper where it either drains laterally in the coarse sand layer or infiltrates the compacted soil layer (radon barrier).

The top slope was seeded with grasses, but the low water-storage capacity of the thin (nominal 4-inch-thick) topsoil layer has limited grass growth to scattered patches of deeper-rooted wheat grasses. The total vegetative cell cover has gradually increased over the years as patches of deeper-rooted grasses have spread (PL–1); however, the vegetative cover was not as heavy in 2007 as in some previous years because of dryer conditions. Perennial and annual species, although limited, are also establishing on the cell top. Most of the top slope still has sparse vegetation compared to surrounding undisturbed plant communities.

Movement of precipitation through the riprap and bedding layers and into the radon barrier also favors the growth of shrubs. Sagebrush, rabbitbrush, and bitterbrush, which are the dominant plant species surrounding the site, have been establishing on the top of the disposal cell. During the 2007 inspection it was noted that the shrub density continues to increase. Shrub density likely will continue to increase until it approaches or exceeds levels observed in native plant communities adjacent to the site.

9A **Disposal Cell Cover Performance Evaluation**— Field investigations at the site indicate that a combination of soil development and root intrusion by the deep-rooted shrubs has increased the hydraulic conductivity of the radon barrier in the cell cover, allowing meteoric water to percolate into the underlying tailings.

Encroachment by deep-rooted shrubs was observed shortly after construction of the disposal cell. As designed and constructed, the cover is a favorable habitat for deep-rooted plants. Root intrusion and soil development have increased the permeability of the radon barrier. In situ tests have shown that the saturated hydraulic conductivity of the radon barrier ranges between 1×10^{-6} and 1×10^{-4} centimeters per second (cm/s) (the design target was 1×10^{-7} to 1×10^{-8} cm/s).

In fall 2005, LM began an evaluation of a new device called a water flux meter, a passive wicking lysimeter, to directly measure percolation flux through the Lakeview disposal cell cover. Three water flux meters, installed in holes augered through the top slope of the cover and into tailings, capture percolation just below the compacted soil layer in the cover. Monitoring results in 2006, a wet year, and in 2007, a dry year, both show significant percolation through the cover, primarily during winter and spring months. Cumulative percolation averaged 996 millimeters (mm) during 2006 and 186 mm during 2007. These values are assumed to be greater than the mean percolation for the cover because the three water flux meters were intentionally placed in downslope locations where water accumulates in the sand drainage layers. The evaluation also includes monitoring of moisture content in the tailings. Tailings beneath the side slope of the disposal cell remained saturated during the entire 2-year period. Additional information is available in *Monitoring Percolation in the Engineered Cover at the Lakeview, Oregon, Disposal Cell: 2007 Progress Report*.

Studies of natural systems in the area (natural analog studies) have provided evidence for scenarios of the long-term performance of the cover. Some inferences that have emerged from these natural analog studies follow:

- Plant succession and soil development on the cover may lead to even greater permeability of the radon barrier.
- Soil development and plant succession on the cover may also lead to an increase in evapotranspiration, keeping the radon barrier unsaturated and, hence, effectively offsetting the increase in permeability.
- As rock riprap on the cover degrades, vegetation growing in the rocky soil that will likely develop on side slopes may be adequate for long-term erosion control.

Side Slopes of the Disposal Cell and Adjacent Drainage Channel, Aprons, and Trench Drains—The general appearance of the riprap-covered features is good. The side-slope cover shows no sign of slumping or movement.

Encroachment of grass has increased in the riprap on the north side slope, in the upper (eastern) part of the drainage channel, in the energy dissipation area at the lower end of the drainage channel, and the western apron area. Grasses in these areas are now well established. Areas of dead grasses and mossy vegetation observed along the western toe suggest wetter periods of growth in the past two years compared to the current drier conditions. Relatively sparse plant growth in the drainage channel is not significant and does not degrade the function of the channel.

Standing water observed over several years was absent from the large depression in the energy dissipation area at the lower end of the drainage channel. Water is a concern because inundation may accelerate deterioration of the large riprap due to freeze-thaw processes and secondary mineralization or alteration.

Riprap Condition Evaluation—Riprap for the disposal cell was sized to withstand the erosive energy of a probable maximum precipitation event—a conservative, worst-case scenario in which the most severe meteorological conditions possible combine and occur at the same time. Deterioration of riprap on the west and north side slopes and in the energy dissipation area at the lower end of the drainage channel is an ongoing concern because the percentage of crumbling rocks on the surface had noticeably increased since the riprap was placed in 1989.

9B The original design specified a side slope riprap mean rock diameter (D_{50}) of 2.7 inches. Subsequent observations indicated that the riprap could degrade to a size less than the design D_{50}. To determine if the riprap degradation posed a risk of cell erosion, DOE recalculated the minimum D_{50} using the U.S. Army Corps of Engineers Hydrologic Modeling System computer model currently accepted by NRC. The recalculated minimum D_{50} necessary to protect the disposal cell is 1.8 inches. DOE submitted a revised LTSP in 2002 addressing the recalculated minimum D_{50}; NRC concurrence is pending.

9C Annual rock degradation monitoring of side slope riprap was performed for the eleventh year during the 2007 inspection (PL–3). Particle size distribution (weight percent) by count data was collected at 20 locations. The 2007 results indicate a mean D_{50} of 2.32 inches with a 95 percent confidence interval between 2.14 and 2.51 inches (Figure 9–2). The mean D_{50} in 2006 of

2.26 inches was slightly smaller than the 2007 result. The D_{50} value measured for 2007 is similar to values measured for most of the previous 5 years: 2002 (D_{50} = 2.35 inches), 2003 (D_{50} = 2.74 inches), 2004 (D_{50} = 2.48 inches), 2005 (D_{50} = 2.41 inches), and 2006 (D_{50} = 2.26 inches). The mean D_{50} for the previous five years (prior to 2007) is 2.45 inches.

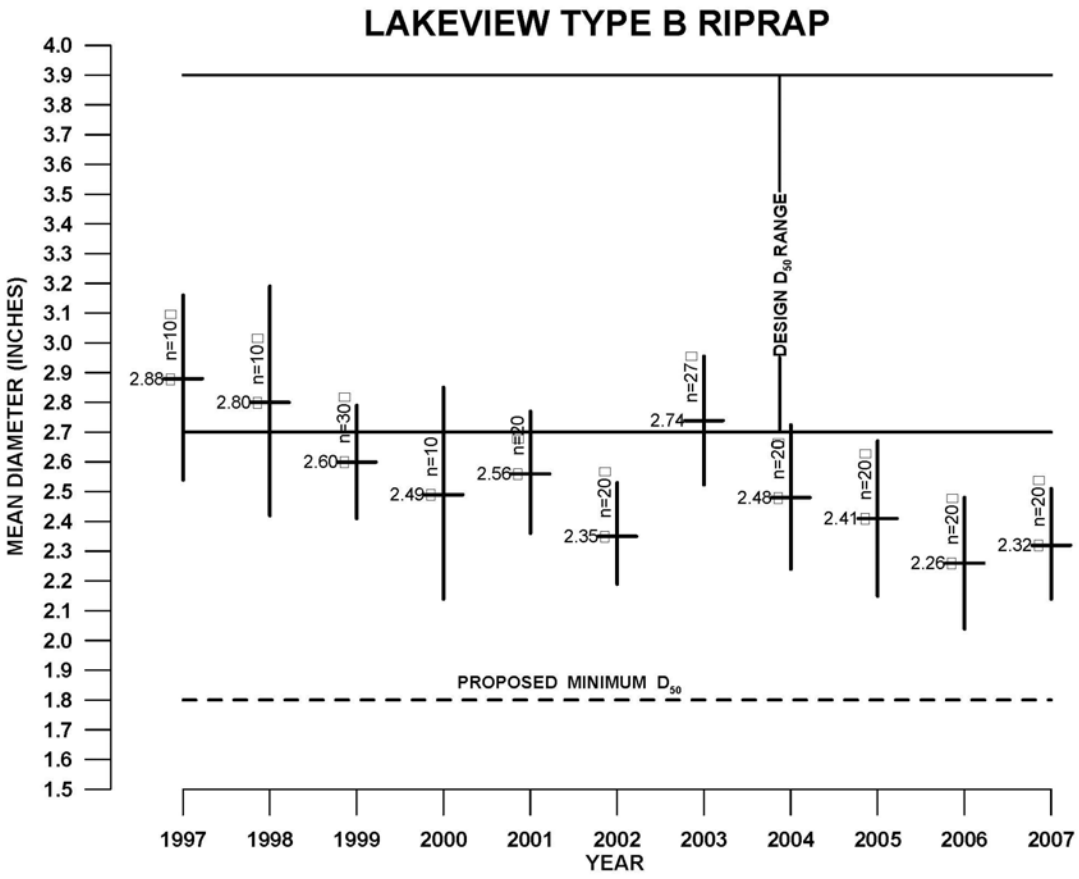

Figure 9–2. Side Slope Riprap Size Monitoring Results for the Lakeview, Oregon, Disposal Site

Detailed measurements of this erosional process began in 1997. Since that time the mean diameter has decreased about 20 percent. The D_{50} values measured for 2003 and 2007 show slightly upward or increasing trends, but the overall trend of D_{50} rock sizes from 1997 to the present suggests a gradual decrease in size. However, initially (1997 to 1999) the trend appeared to be more rapid than in more recent years. This initial more rapid decreasing trend may be because the basaltic rocks used on the side slope were predisposed to chemical or physical weathering and reacted more quickly to newly imposed surface conditions during the first decade (1989 to 1999) after cell completion. Therefore, the first decade of rock weathering may have seen the greatest and most rapid loss of rock integrity. The overall decrease in size may represent a minimum decrease in rock size because rock diameters are measured from surface samples and smaller fragments, derived from crumpling rocks, may have fallen into the interstices, thus producing a biased sample. Nevertheless, the current method of rock-size measurement has been performed for the past eleven years and does provide a consistent metric for cover material changes.

DOE will continue annual rock gradation monitoring of riprap to ensure that the side slopes of the disposal cell are protected from erosion. If it becomes apparent that the side slope riprap is continuing to deteriorate and that the measured D_{50} will eventually fall below 1.8 inches, DOE, in consultation with NRC, will evaluate alternatives and take corrective action, as necessary.

In addition to the side slope riprap monitoring discussed above, DOE also performs long-term monitoring of riprap at a second location (the energy dissipation area) through the use of annual comparative photographs. Eighteen points in the energy dissipation area were re-photographed (PL–4). Minimal rock degradation has been observed since monitoring began at the original ten locations established in 1997 or at the eight additional locations established in 2000.

Site Perimeter and Outlying Area— This transect includes the area extending from the disposal cell to the site boundary and the area within 0.25 mile surrounding the site.

Gullies that formed in seeded areas extending west of Trench Drains 1, 2, 3, 4, and 5 were filled with rock in 2000. The rock has arrested the headcutting that was proceeding from the Collins Ranch property onto the DOE property. Small gullies observed forming downslope of the rock were not large enough to warrant repair. Additional small gullies have been observed in the southwest corner of the site just inside the perimeter fence and downhill of an inclined road that intersects the fence line. These small gullies are likely the result of runoff from the road during rain events. The gullies did not show recent erosion in 2006 or 2007 and present no immediate cause for concern.

The area within 0.25 mile of the site boundary was unchanged from 2006.

9.3.2 Follow-up or Contingency Inspections

DOE will conduct follow-up inspections if (1) a condition is identified during the annual inspection or other site visit that requires a return to the site to evaluate the condition, or (2) DOE is notified by a citizen or outside agency that conditions at the site are substantially changed.

No follow-up or contingency inspections were required in 2007.

9.3.3 Routine Maintenance and Repairs

No routine maintenance and repairs were performed in 2007.

9.3.4 Groundwater Monitoring

DOE monitors groundwater quality in the uppermost aquifer at this site once every 5 years to demonstrate the disposal cell is not leaching contaminants. The most recent sampling event was performed in 2004. No monitoring was performed in 2007. Constituents analyzed every 5 years include arsenic, cadmium, and uranium. Their respective maximum concentration limits (MCLs), established by the U.S. Environmental Protection Agency in Table 1 to Subpart A of 40 CFR 192, are 0.05 milligrams per liter (mg/L), 0.01 mg/L, and 0.044 mg/L. Concentrations of these constituents were well below their respective limits in 2004 (the last monitoring results) and were consistent with sampling results from 1999. Based on the monitoring results to date, there is no indication of any degradation of groundwater in the vicinity of the site. The next cell performance monitoring is scheduled for 2009.

9.3.5 Corrective Action

Corrective action is taken to correct out-of-compliance or hazardous conditions that create a potential health and safety problem or that may affect the integrity of the disposal cell or compliance with 40 CFR 192.

No corrective action was required in 2007.

9.3.6 Photographs

Table 9–2. Photographs Taken at the Lakeview, Oregon, Disposal Site

Photograph Location Number	Azimuth	Description
PL–1	0	Vegetative cover on top of cell.
PL–2	90	Site marker SMK–2 and meteorological station in background.
PL–3	30	Rock measurements on side slope.
PL–4	NA	Riprap monitoring location 7 at the energy dissipation area.

LKV 7/2007. PL–1. Vegetative cover on top of cell.

LKV 7/2007. PL–2. Site marker SMK–2 and meteorological station in background.

LKV 7/2007. PL–3. Rock measurements on side slope.

LKV 7/2007. PL–4. Riprap monitoring location 7 at the energy dissipation area.

End of current section.